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# PATENT ABSTRACTS OF JAPAN

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## (54) WELDING METHOD

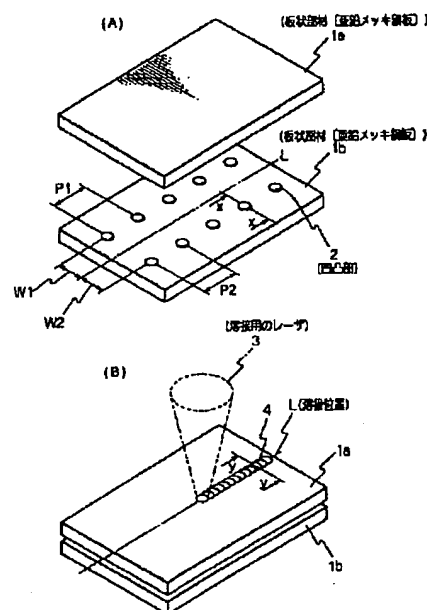
### (57) Abstract:

**PROBLEM TO BE SOLVED:** To shorten the working man-hour, and to suppress the equipment cost by irradiating the prescribed laser beam on the surface of a plate-like member to be welded in advance to form ruggedness, laminating the plate-like members so as to hold the surfaces to be welded on which ruggedness is formed, and irradiating the laser beam for welding on the prescribed part of each laminated plate-like member.

**SOLUTION:** The plurality of rows of rugged parts 2 with the interval P1 is formed at the advance W1 from a welding position L on each side of the welding position L in a galvanized steel plate 1b. The plurality of rows of rugged parts 2 with the interval P2 is formed at the distance W2 from the welding position L. The galvanized steel plate 1a is a regular galvanized steel plate free from any rugged part on its surface. When the galvanized steel plate is irradiated with the pulse-like laser beam, the molten metal is moved toward the outer circumferential part of molten part, the outer circumferential part is slightly raised, and solidified to form the rugged part 2. The galvanized steel plates 1a, 1b lam-

inated on each other are irradiated with the laser beam 3 along the welding position L to achieve the lap welding of the galvanized steel plates 1a, 1b.

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## Übersetzung der japanischen Offenlegungsschrift JP 11 047 967 A

(maschinell)

### [Claim(s)]

[Claim 1] In the welding process which piles up the plate-like part material of at least two sheets, and is welded mutually The concavo-convex section formation process which irradiates a predetermined laser beam in the welding side of plate-like part material, and forms the concavo-convex section in a front face beforehand, The welding process which consists of a superposition process which piles up plate-like part material so that it may face across the welding side in which this concavo-convex section was formed, and a welding process which irradiates the laser beam for welding in the piled-up predetermined part concerned of each plate-like part material.

[Claim 2] The welding process which consists of the concavo-convex section formation process which irradiates a laser beam in the welding side of a galvanized steel sheet, and forms the concavo-convex section in a front face beforehand in the welding process which piles up the galvanized steel sheet of at least two sheets, and is welded mutually, a superposition process which piles up plate-like part material so that it may face across the welding side in which this concavo-convex section was formed, and a welding process which irradiates the laser beam for welding in the piled-up predetermined part concerned of each galvanized steel sheet.

[Claim 3] The welding process according to claim 1 or 2 characterized by using a pulse-like laser beam in the aforementioned concavo-convex section formation process.

[Claim 4] The claim 1 characterized by forming the aforementioned concavo-convex section in the circumference of the welding position which irradiates the laser beam for the aforementioned welding, and the welding process of invention 2 publication.

[Claim 5] The welding process according to claim 1 or 2 characterized by setting the interval of this concavo-convex section to 5mm or less while forming two or more aforementioned concavo-convex sections.

### [Detailed Description of the Invention]

[0001]

[The technical field to which invention belongs] this invention relates to a welding process, especially relates to the superposition welding process of the plate-like part material by laser.

[0002]

[Description of the Prior Art] In order to have piled up and welded the plate-like part material by which the low quality of the material of the melting point is painted by laser from the base material like [ before ] a galvanized steel sheet, the moderate crevice was prepared between each plate-like part material, and to miss the steam of the paint material generated at the time of welding was confirmed. For example, in superposition welding of a galvanized steel sheet, a predetermined spacer is put in between the galvanized steel sheets to pile up, and concavo-convex processing of the galvanized steel sheet is carried out with a press as indicated by JP,56-62688,A. This is the method of making the recess path of the zinc steam which prepares a crevice between the galvanized steel sheets to pile up, and is produced at the time of

welding.

[0003] In addition, U.S. patent number Predetermined notching and a predetermined slit are prepared near the welding position which carries out laser welding, and the method of securing the recess path of a zinc steam is proposed as indicated by No. 5,451,742.

[0004]

[Problem(s) to be Solved by the Invention] However, there were following un-arranging in the above-mentioned conventional example. That is, the method of putting in a spacer between the galvanized steel sheets piled up and \*\*\*\*\*ed mutually, the method of carrying out press working of sheet metal so that the concavo-convex section may be formed in a galvanized steel sheet, and any method of preparing notching and a slit near the weld-zone grade need to change the configuration of notching, and the configuration of a slit according to the configuration of a work. For this reason, it will be necessary to change a processing configuration for every work, and had produced un-arranging [ that a processing man day increased and a conversion cost increased ].

[0005] Moreover, since the configuration of the work itself deforms with a press in pressing a work, it is unsuitable to weld the member of a plane. In addition, since processing configurations differed for every work, the production line for every work was needed, and it had produced un-arranging [ that versatility was lost in the composition of a production line ].

[0006]

[Objects of the Invention] It improves un-arranging [ which the above-mentioned conventional example has ], the processing process before welding can be managed in a short time especially compared with the conventional method, and this invention sets it as the purpose to offer the galvanized steel sheet superposition welding process by the laser which can suppress elevation of a conversion cost.

[0007]

[Means for Solving the Problem] In order to solve the above-mentioned technical problem, in invention according to claim 1 In the welding process which piles up the plate-like part material of at least two sheets, and is welded mutually The concavo-convex section formation process which irradiates a predetermined laser beam in the welding side of plate-like part material, and forms the concavo-convex section in a front face beforehand, The method of consisting of a superposition process which piles up plate-like part material so that it may face across the welding side in which this concavo-convex section was formed, and a welding process which irradiates the laser beam for welding in the piled-up predetermined part concerned of each plate-like part material is taken. Even when a part of plate-like part material evaporates with the heat of welding by having been constituted as mentioned above, these above is certainly discharged by the crevice formed between each plate-like part material of the concavo-convex section.

[0008] In the welding process which piles up the galvanized steel sheet of at least two sheets, and is mutually welded in invention according to claim 2 The concavo-convex section formation process which irradiates a laser beam in the welding side of a galvanized steel sheet, and forms the concavo-convex section in a front face beforehand, The method of consisting of a superposition process which piles up plate-like part material so that it may face across the welding side in which this concavo-convex section was formed, and a welding process which irradiates the laser beam for welding in the piled-up predetermined part concerned of each galvanized steel sheet is taken. Even when the boiling point evaporates by having been constituted as mentioned above and low zinc evaporates by heating of laser, it is certainly discharged from the mutual crevice between each galvanized steel sheet.

[0009] In invention according to claim 3, the method of using a pulse-like laser beam is taken in a concavo-convex section formation process; and the other methods are the same as that of invention according to claim 1 or 2. Since high power laser with high peak intensity can be irradiated by having been constituted as mentioned above, the suitable concavo-convex

section can be formed.

[0010] The method of forming the aforementioned concavo-convex section in the circumference of the welding position which irradiates the laser beam for the aforementioned welding in invention according to claim 4 is taken, and the other methods are the same as that of invention according to claim 1 or 2. Welding intensity is also uniformly securable, while the crevice between each plate-like part material of a welding position or a galvanized steel sheet serves as height of the concavo-convex section correctly and can discharge a steam certainly, if each plate-like part material piles up by having been constituted as mentioned above.

[0011] Furthermore, while forming two or more concavo-convex sections in invention according to claim 5, the method of setting the interval of this concavo-convex section to 5mm or less is taken, and the other methods are the same as that of invention according to claim 1 or 2. By having been constituted as mentioned above, each plate-like part material or galvanized steel sheets pile up stably.

[0012]

[Embodiments of the Invention] Next, the gestalt of operation of the 1st of this invention is explained in detail with reference to a drawing.

[0013] As for galvanized steel sheet 1b, reference of drawing 1 (A) forms the train of two or more concavo-convex sections 2 of an interval P1 in the place of distance W1 from the welding position L at the both sides of the welding position (welding line) L. Moreover, the train of two or more concavo-convex sections 2 of an interval P2 is formed in the place of distance W2 from the welding position L. On the other hand, galvanized steel sheet 1a is the usual galvanized steel sheet which does not have the concavo-convex section in a front face.

[0014] The concavo-convex section 2 is formed like drawing 2. That is, if the pulse-like laser 7 is irradiated at galvanized steel sheet 1a, surface zinc 5 will evaporate and melting of the steel plate 6 will be carried out. And the phenomenon in which a hole is dug by the fusion zone of a steel plate 6 with the reaction force of laser 7 at the time of melting happens. At this time, molten metal moves to the periphery section of a fusion zone, and the periphery section rises for a while. If irradiation of laser 7 is suspended in such the state, a fusion zone quenches, and it will solidify with this configuration, and will rise, and h will be formed. Depending on the irradiation conditions of laser 7, the molten metal of the periphery section may return to a center section, and a center section may rise conversely.

[0015] The laser 7 irradiated in order to form the concavo-convex section 2 can consider various pulse shape, as shown in drawing 3 or drawing 6. Although most drawing 3 (A) at the usual square wave is used, it is also effective like drawing 3 (B) to adjust laser intensity. Moreover, there are also a method of making it a multi-stage wave and lowering laser intensity gradually like drawing 4 (A), and the method of making it a multi-stage wave and raising laser intensity gradually, as shown in drawing 4 (B). In addition, in drawing 4, although it is a two-step wave, three or more steps of two or more steps are sufficient. Moreover, as shown in drawing 5 (A), a wave which combined a double pulse which fixes the whole energy to a predetermined value and is divided into two pulses, and a square wave as shown in drawing 5 (B) and a double pulse is sufficient. A triple pulse which sets the number of pulses to three also in this case, or more than it is sufficient. Furthermore, a square wave which has the high short pulse of a peak at the time of a pulse standup as shown in drawing 6 (A), and the wave made to transform the power of a square wave in curve as shown in drawing 6 (B) are sufficient. In addition, the wave which combined mutually each wave explained above is also considered.

[0016] The configuration of the remains of laser radiation can be made to deform if needed with these wave configurations.

[0017] Drawing 7 is what showed the cross-section configuration of the concavo-convex section 2, and shows the conceptual diagram of the cross section in the X-X line of drawing 1

into two, and drawing 5 (B) shows the wave which combined the double pulse of a square wave and drawing 5 (A).

[Drawing 6] It is drawing showing the wave of the laser at the time of forming the concavo-convex section, and drawing 6 (A) shows a square wave which has the high short pulse of a peak at the time of a pulse standup, and drawing 6 (B) shows the wave made to transform the power of a square wave in curve.

[Drawing 7] The cross section in the X-X line of drawing 1 is shown.

[Drawing 8] It is the cross section showing the state where the galvanized steel sheet was piled up before welding of the welding process by this invention.

[Drawing 9] The cross section in the Y-Y line of drawing 1 after a welding process is shown.

[Drawing 10] It is the plan showing the formation pattern of the concavo-convex section formed in plate-like part material or a galvanized steel sheet, and drawing 10 (A) shows the case where it has arranged equally to a welding position, drawing 10 (B) shows the state where right and left were shifted, and drawing 10 (C) shows the case where it forms irregularly.

#### **[Description of Notations]**

1a Galvanized steel sheet

1b The galvanized steel sheet in which the remains of laser radiation were formed on the front face

2 Concavo-convex Section

3 Laser

4 Weld Bead

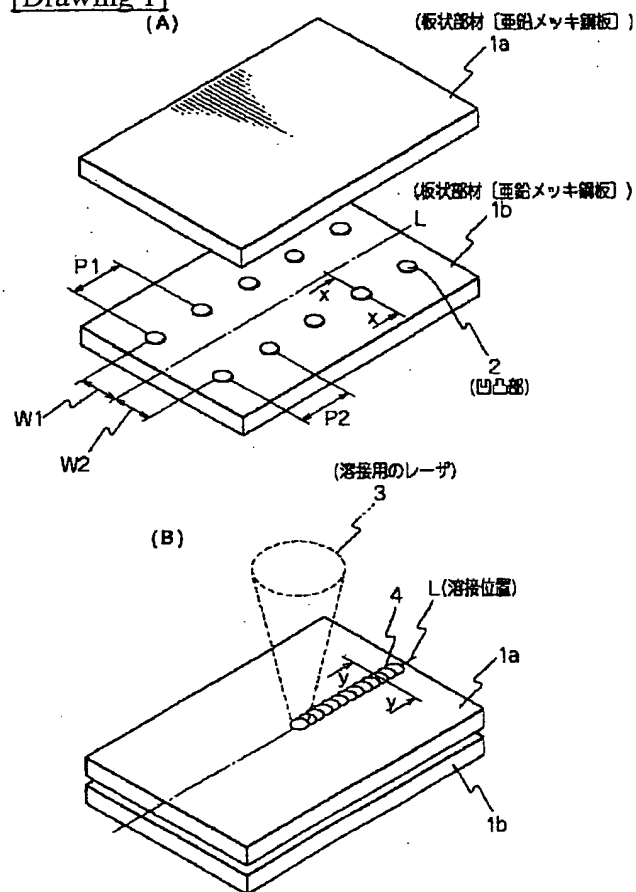
5 Zinc

6 Steel Plate

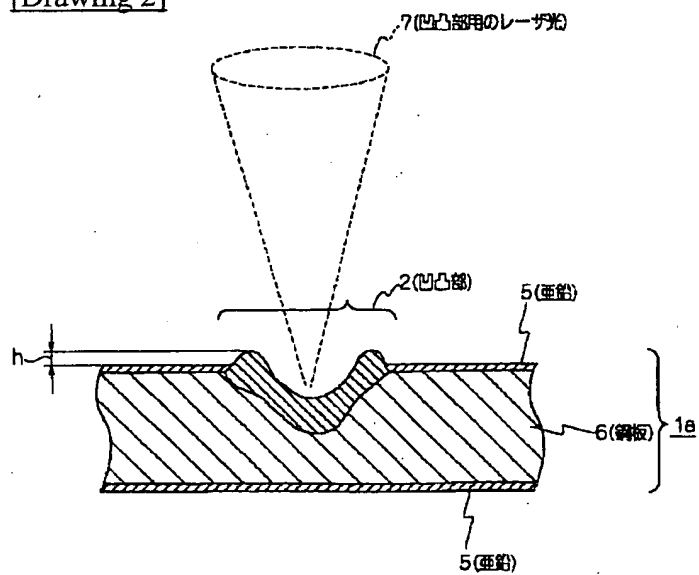
7 Pulse Laser for Concavo-convex Sections

# DRAWINGS

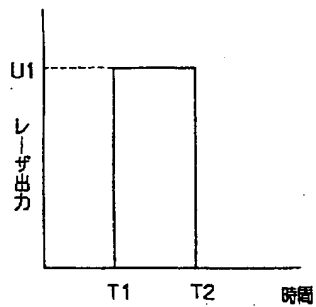
[Drawing 1]



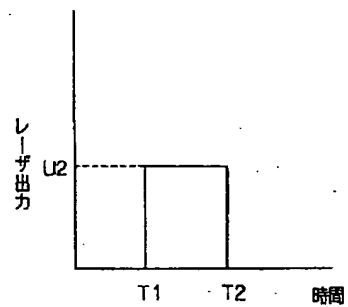
[Drawing 2]



[Drawing 3]  
(A)

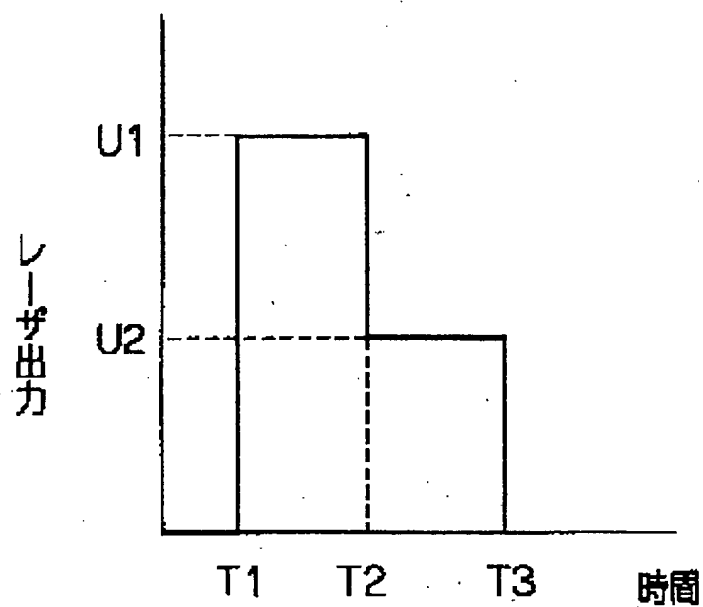


(B)

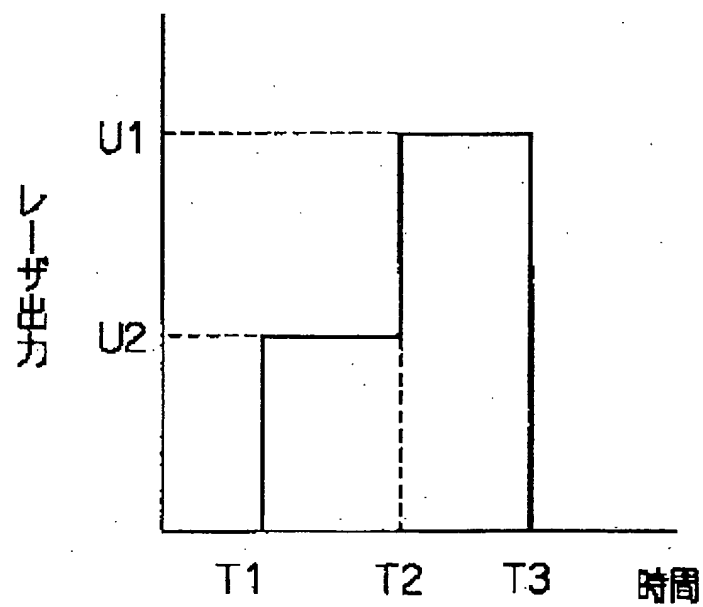


[Drawing 4]

(A)

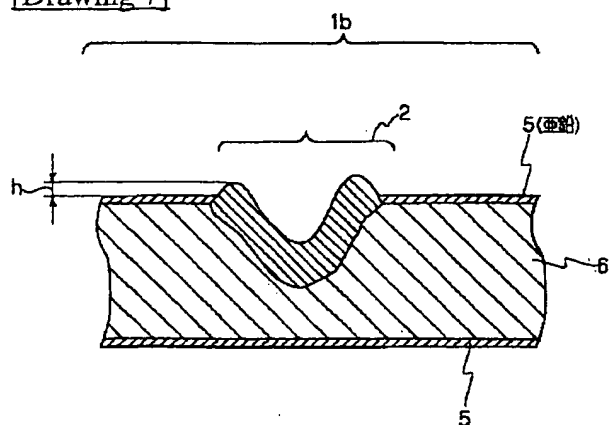


(B)



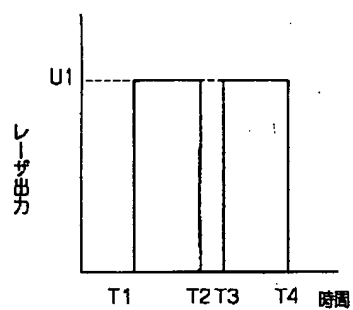


[Drawing 7]

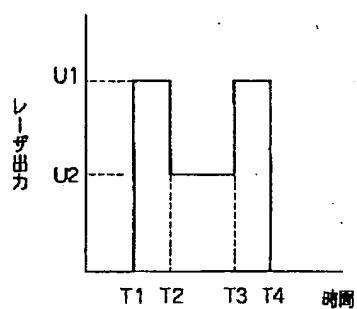


[Drawing 5]

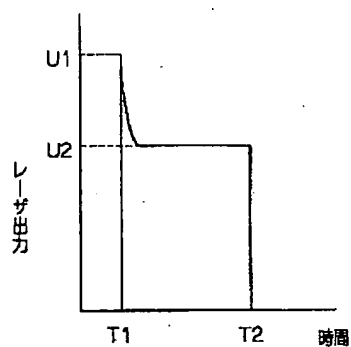
(A)



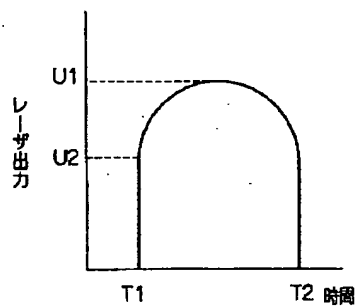
(B)



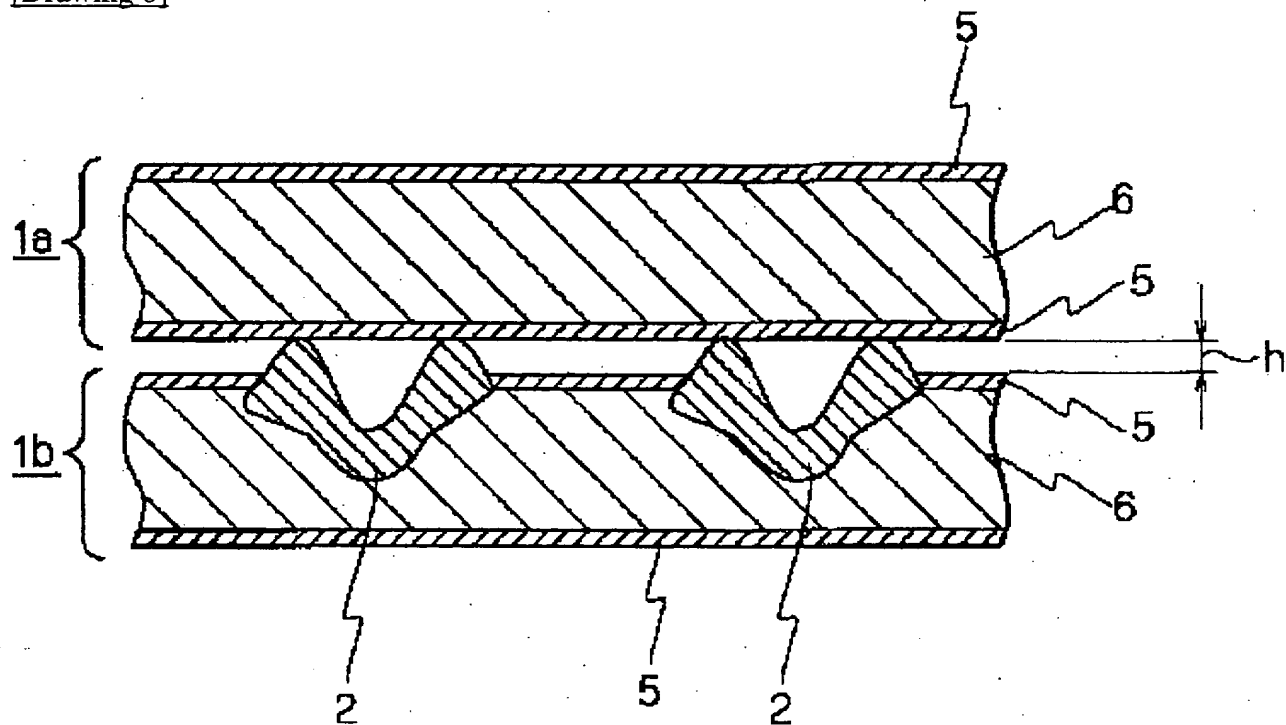
[Drawing 6]  
(A)



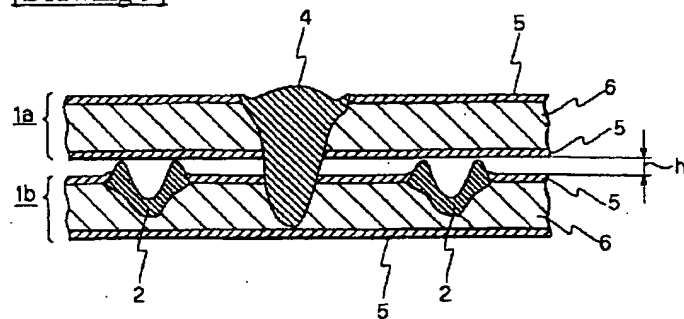
(B)



[Drawing 8]



[Drawing 9]



[Drawing 10]

